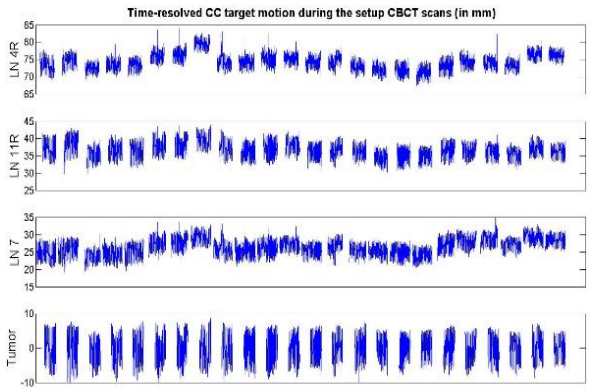

a) Span of day-to-day differential shifts of LNs relative to tumor

	LR (mm)	CC (mm)	AP (mm)
LN 4R	(0-7.2)	(0-9.5)	(0-9.0)
LN 11R	(0-5.2)	(0-5.3)	(0-7.7)
LN 7	(0-4.9)	(0-5.3)	(0-6.2)

b) Mean motion amplitudes

	LR (mm)	CC (mm)	AP (mm)
Tumor	2.1 (0.8-3.9)	14.1 (10.3-17.1)	2.1 (1.3-3.2)
LN 4R	3.1 (2.0-5.3)	6.6 (4.7-10.6)	4.7 (3.4-8.3)
LN 11R	1.9 (0.9-2.9)	7.7 (5.9-10.3)	2.9 (1.8-5.4)
LN 7	2.6 (2.1-3.4)	7.3 (5.3-9.3)	2.9 (2.1-4.7)

Conclusions: Highly detailed time-resolved internal 3D motion was determined throughout lung IMRT using standard imaging equipment and presented for one out of four recruited patients. While the tumor motion was governed by respiration, the LNs had substantial cardiac induced motion. More patients will soon be included in the study.

PD-0460

Performance of digital tomosnythesis for tumor motion monitoring: a phantom study

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Purpose/Objective: Short arc digital tomosnythesis (DTS) is a technique for reconstructing volumetric images in planes parallel to the detector plane using limited numbers of kV projections. It provides better contrast compared to traditional X-ray images as DTS reduces over-projections from other planes. DTS may provide fast positional monitoring for mobile stereotactic lung targets. We evaluated the potential of DTS for motion monitoring in a moving lung phantom by comparing DTS images generated from CBCT fluoroscopic images, with reference CT images.

Materials and Methods: A heterogeneous lung phantom (Quasar) with mobile lung insert containing a polystyrene sphere was used. Aluminum strips were paced around the phantom to simulate ribs. CBCT scans of the phantom with sinusoidal motions (5 to 20 mm in longitudinal direction, period of 3 to 5 s) and 3 clinical irregular motion patterns were acquired on a TrueBeam linac. To simulate lateral and vertical motion, the phantom was rotated 7° and tilted 3° and CBCTs with sinusoidal motions (10 and 20 mm, period of 3 and 5 s) and 2 clinical irregular motion patterns were acquired. DTS images were generated using research software (Varian Medical Systems) and 2D-registered to DTS images from reference CT-datasets acquired in the same position. DTS images were created using 3° arc segments for every 3° of arc rotation. Since shorter DTS angles reduce the plane-plane resolution, the third dimension (combination of vertical and lateral directions) was obtained by triangulating the registration data with data obtained >3° earlier. All registered data were compared to motion profiles of the lung insert.

Results: For sinusoidal motion, the combination of motion amplitudes and frequencies resulted in average target speed 2 to 13.3 mm/s. For longitudinal sinusoidal motion, the average absolute registration error was 0.4 ± 0.2 mm and correlated to the target speed (P=0.008, Pearson's correlation). For target speed <10 mm/s, errors were <0.5 mm with SD ≤ 0.4 mm. The analyses of random motion patterns showed the same trend. The 3 random motion patterns (average speed of 8.1, 5.7 and 3.3 mm/s) showed absolute matching errors of 1.0 ± 1.3mm, 0.6 ± 0.5mm and 0.3 ± 0.4mm, respectively. For 3D sinusoidal motions with the tilted phantom (10/20 mm and 3/5 seconds), average absolute errors were 0.2 ± 0.2mm, 0.5 ± 0.5mm, 0.2 ± 0.1mm, for vertical, longitudinal, lateral directions respectively. Figure 1 shows 3D motion detected by DTS combined with triangulation and the reference random motion profile. Absolute errors for x-, y- and z-axes were 0.4 ± 0.3mm, 0.7 ± 0.5mm and 0.6 ± 0.5mm respectively.

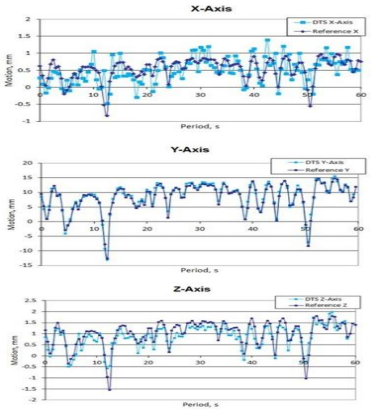

Figure 1. Motion detected using DTS and reference motion patterns in lateral, longitudinal and vertical directions.

Conclusions: Using short arc DTS plus triangulation, tumor location in a phantom can be verified every second, even for irregular motion. DTS in combination with triangulation merits further evaluation as a fast online solution for tracking mobile lung tumors.

PD-0461

Population-based vs patient-specific margins for intra-fractional motion in adaptive bladder radiotherapy

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Purpose/Objective: The bladder is an appealing target for adaptive radiotherapy (ART) strategies due to large inter-fractional motion and deformations, but it may also display considerable intra-fractional changes. The aim of this study was initially to calculate population-based margins for intra-fractional bladder changes using a comprehensive data set of repeat volumetric magnetic resonance imaging (MRI), and secondly to explore the possibilities of deriving patient-specific intra-fractional margins, relevant in particular within the setting of online ART for bladder cancer.

Materials and Methods: Nine patients treated in a phase II clinical plan selection ART trial for bladder cancer were included. The patients underwent pre-treatment and weekly repeat MRI series (mDixon sequence; voxel size: 0.9×0.9×1.5 mm; scan time: 40 s), where in each series a volumetric scan